Handling & Storage of Electrodes

1.0 INTRODUCTION:

An electrode is several times more expensive than the corresponding alloy in wrought form. Its cost further increases due to stub & spatter loss during the welding operation. Hence an electrode needs to be handled and used with proper care.

1.1 The Do's

1. Follow parameters recommended by manufacturer.
2. Keep the electrode packets gently while movement & use to avoid flux peel off.
3. Re-dry the electrodes as recommended by the manufacturer.
4. If hydrogen controlled electrodes of different strength levels are re-dried together in an oven, select the highest temperature applicable.

1.2 The Do Not's

1. Bending the electrode before use – may cause flux cracking.
2. Hitting the striking end hard on the job – may cause flux peel off.
3. Use of higher current than those recommended by the manufacturer – may overheat the electrodes and cause decomposition or disintegration of the coating. The phenomena may result to porosity, reduced penetration, higher nitrogen contents in the weld and reduced ductility & toughness. E6013, E6010, E6011, E6012 electrodes are highly sensitive to overheating.
4. Contamination of electrodes with oil, grease, etc.
5. Exposure of electrodes in a humid environment – may pick up moisture and the flux may undergo chemical reaction within the coating.
6. Transferring the wet/ moist electrodes immediately at higher temperature of the oven – may cause coating cracks.
7. Use of same oven for at a time redrying of hydrogen controlled electrodes and non-hydrogen controlled electrodes.

8. Redrying of electrodes beyond 430˚C – may cause oxidation of the ferro-alloys.

9. Redrying the electrodes beyond the time limit – may deteriorate the strength of coating.

10. Opening the oven every now & then at the time of re-drying or soaking.

2.0 MOISTURE IN FLUX COATING:

Moisture in a basic type flux coated electrodes is very significant. In the welding arc, it dissociates into atomic hydrogen and oxygen. As oxygen reacts to form oxides, hydrogen goes into deposited weld metal. The presence of hydrogen is reported in the host lattice and in the atomic & micro-structural defects such as vacancies, dislocations, grain boundaries, micro-voids and second phase particles. The dissolved hydrogen then assists in the fracture of the metal, possibly by making cleavage easier or possibly by assisting in the development of intense local plastic deformation. These effects lead to embrittlement of the metal; cracking may be either inter-granular or trans-granular. Crack growth rates are typically relatively rapid, up to 1 mm/s in the most extreme cases. So, the presence of hydrogen is controlled in the high strength weld metals especially when the strength crosses beyond the 80 ksi values.

Control on moisture in the electrode coating leads to various grades of low hydrogen electrodes. H15, H10, H5 wherein 15, 10 & 5ml of diffusible hydrogen is specified in 100 grams of weld metal. However, as the propensity of such crack formation increases with the strength of the weld, it is always desired to have an extra low hydrogen electrode (below 3ml) for joining high strength steels.

A major proportion of basic-coated electrodes ingredients are hygroscopic in nature. This makes the basic type electrodes highly prone to moisture pick up, aggravating the tendency to deposit high-hydrogen weld metal.

A fresh electrode immediately after baking (400-500°C) shows between 0.20-0.25% moisture in the flux coating. However, when left open in an open atmosphere, it picks up moisture. The moisture content of the coating flux may go beyond 1.0% depending on the duration and condition of exposure.

These types of electrodes therefore, need re-drying prior to use to drive-off the moisture from the electrode coating. It is generally done at 300-350°C for 2 hours or followed as per the recommendations of the electrode manufacturer.

Limited data are available in the literatures to establish a relation between moisture content & diffusible hydrogen content of the weld metal. Also, these values are dependant on specific flux design. However, studying the various results and also from the analyses of available data in the literatures, it can be assumed that, to restrict hydrogen content below 5.0ml per 100gms of weld metal, the moisture content of the coating shall not exceed 0.48% at the time of welding.

3.0 STORAGE CONDITIONS OF ELECTRODE (CLAUSE 4.5.2 OF AWS D1.1):

All electrodes having low hydrogen covering conforming to AWS 5.1 shall be purchased in hermetically sealed containers or shall be dried for at least two hours between 260°C to 430°C before they are used. Electrodes conforming to AWS 5.5 shall be purchased in hermetically sealed containers or shall be dried for at least one hour at 370°C to 430°C before they are used. If the hermetically sealed container shows evidence of damage, electrodes shall be dried prior to use.

Electrodes shall be stored in ovens held at a temperature of at least 120°C, immediately after opening of hermetically sealed container or removal of the electrodes from drying ovens. Electrodes that conform to this provision shall subsequently be re-dried no more than one time. Electrodes that have been wet shall not be used.

When welding for ASTM A514 or ASTM A517 grade steels, electrodes of any classification lower than E100XX-X, except for E7018M and E70XXH4R, shall be dried at least one hour at temperatures between 370°C to 430°C before being used, whether furnished in hermetically sealed containers or otherwise.